

DAMES & MOORE JOB NO. 01375-062-06
Salt Lake City, Utah
December 13, 1985

REPORT
COST ESTIMATE
COMPLIANCE WITH PROPOSED RULEMAKING
REINTERPRETATION OF THE
SMELTING AND REFINING WASTE EXCLUSION
FOR KENNECOTT

Dames & Moore



Dames & Moore



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December 13, 1985

Kennecott
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Attention: Mr. Robert Malone

Gentlemen:

Report
Cost Estimate
Compliance With Proposed Rulemaking
Reinterpretation of the
Smelting and Refining Waste Exclusion
For Kennecott

INTRODUCTION

This report presents cost estimates for probable hazardous waste disposal actions which would become mandatory under EPA rulemaking concerning reinterpretation of the RCRA smelting and refining waste exclusions (50 Federal Register 40292, October 2, 1985). The primary focus of this proposed rulemaking with respect to the interests of Kennecott involves the relisting of EPA Hazardous Waste No. K064. This waste is acid plant blowdown slurry/sludge resulting from the thickening of blowdown slurry from primary copper production. The magnitude of financial expenditures necessary for compliance with enacted legislation based on the proposed rulemaking is dependent not only on new acid plant blowdown production but also the extent to which Subtitle C of RCRA impacts similar existing waste products.

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Specific Kennecott holdings addressed in this report include refining and/or smelting facilities in Utah, New Mexico, and Arizona. For each facility, a brief review of anticipated production of new hazardous waste as per EPA K064 relisting and existing potentially regulated waste products is given. Basic waste treatment and management technologies expected to be implemented in a hazardous waste disposal program are presented and cost estimates for developing and supporting such programs are provided. To more clearly define the financial obligations associated with a potentially segmented compliance plan, treatment/disposal cost estimates are presented for both anticipated new hazardous waste production and existing waste material anticipated to be subject to Subtitle C regulation.

HAZARDOUS WASTE

GENERAL

In the context of this report, hazardous waste at a given facility is taken to include two basic categories. These are 1) waste related to acid plant blowdown generated after enactment of and pursuant to stipulations of the proposed EPA rule concerning smelting and refining waste exclusion (i.e., new); and 2) previously produced waste products which may come under Subtitle C RCRA regulation in consequence to compliance with the K064 relisting (existing). The expected new waste production and potential existing waste products for each subject facility are presented below.

UTAH

Under conditions of compliance, it is anticipated that the nominal daily production of regulated hazardous waste will be approximately 283 tons resulting in a yearly production of approximately 103,295 tons. Eighty-nine percent of this production (253 T/D) is acid plant blowdown sludge resulting

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from the thickening of blowdown slurry with the remaining 11 percent (30 T/D) being recovered flue dust. Waste production estimates for Utah as well as New Mexico and Arizona are based on weight of dry sludge. The moisture content of the product from the belt filter is estimated at 50 percent. Thus, the weight of the cake from the filter and subsequently the weight used for cost estimation purposes will be approximately twice the weight of dry sludge.

Existing potentially regulated waste products include historic flue dust, sludge present in inactive sludge ponds associated with past wastewater treatment activities, and miscellaneous waste products or contaminated materials resulting from various smelting activities. Establishing total quantities of these existing wastes and fully characterizing them with respect to Subtitle C regulation will require complete field investigations and physicochemical evaluations. However, based on historic production periods and operation logs, quantities of sludge and, to a lesser degree, flue dust can be reasonably forecast for purposes of this cost estimate. The miscellaneous waste product quantities can be estimated with less certainty. These products may include contaminated structural material and contaminated subsoil. The extent of these product types and complete delineation of their spatial and physicochemical characteristics will require thorough review of historic production records and field investigations to identify potentially contaminated areas. Minimum estimated quantities of existing waste material used in the cost estimate are approximately 114,000 tons of sludge and approximately 215,000 tons of flue dust and miscellaneous waste.

NEW MEXICO

Under conditions of compliance, it is anticipated that the nominal production of regulated hazardous waste will be approximately 82 tons per day resulting in a yearly production of approximately 29,930 tons. This waste will be sludge from the treatment and thickening of acid plant blowdown slurry.

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ARIZONA

Under conditions of compliance, it is anticipated that the nominal production of regulated waste will be approximately 36 tons per day resulting in a yearly production of approximately 13,140 ton per year. This waste will be sludge from the treatment and thickening of acid plant blowdown slurry.

The Arizona operation does not have refinery capability. Existing waste products whose status will be impacted by the proposed rulemaking are expected to be limited. Consequently, cost estimates for the Arizona operations will be restricted to the "new" production described in the previous paragraph.

WASTE TREATMENT AND MANAGEMENT TECHNOLOGY

GENERAL

The waste treatment and management technology expected to be utilized in complying with stipulations of the proposed rulemaking will involve wastewater treatment of acid plant blowdown and management of the blowdown sludge in a RCRA secure landfill facility. The physical resources necessary for complete response to mandates in the proposed rulemaking do not exist at the subject facilities and consequently represent immediate substantial financial commitment and long-term maintenance and custodial responsibility.

The following sections briefly describe basic methods or procedures which can be employed for waste treatment and management. Specific details and comprehensive plans for each facility will be dependent not only on the exact nature of any promulgated reinterpretation of the mining waste exclusion but also on the results of site-specific characterization investigations.

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WASTEWATER TREATMENT

A preliminary evaluation of expected influent composition, applicable effluent standards, and operational data from existing wastewater treatment facilities at the subject operations identified key issues with respect to compliance with the proposed rulemaking.

- o Arsenic levels at all facilities would require substantial lowering to meet daily maximum and monthly average BAT effluent limitations.
- o The present effluent from lime treatment at the Utah operation indicates that arsenic, nickel, and lead exceed the expected BAT effluent limitations for direct discharge. Current effluent is being discharged to the tailing pond and tailing pond water is being discharged in compliance with NPDES permit.
- o Selenium concentrations, although not addressed in applicable BAT effluent limitations, are expected to be regulated on a site-specific basis and provisions for selenium mitigation in effluent should be anticipated.

Focusing on these concerns, available technology for the removal of arsenic, selenium, nickel, and lead from wastewater streams was evaluated. Based upon this evaluation, a typical general process flowsheet and equipment lists for wastewater treatment plants at each operation were produced. It should be emphasized that the practical utilization of the selected treatment technology will be dependent upon the characteristics of the actual production influent and the ability of the treatment technology to produce BAT effluent limitations. Theoretically the treatment technology is capable of producing acceptable effluent and limited practical experience with basically similar influent has yielded satisfactory results. Conversely, however the literature contains citations which indicate that the selected treatment technology has not produced acceptable effluent from similar influent. Consequently, the practical effectiveness of the treatment processes must ultimately be evaluated in bench scale studies on anticipated production influent. Should these

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evaluations indicate the selected treatment is not adequate, alternate processes will have to be formulated. Under these circumstances, substantially higher treatment costs would not be uncommon.

The flowsheet and equipment lists in addition to further discussion of treatment requirements and processes are presented in a preliminary feasibility evaluation report prepared by Resource Technologies Group of Denver, Colorado. That report, in its entirety, is provided as an addendum to this report.

WASTE MANAGEMENT

Waste management in the context of this report is taken to include the removal and disposal of the wastewater sludge resulting from wastewater treatment processes. Also included is the removal and disposal, to the extent necessary, of existing waste products whose status may be affected by enactment of the proposed rulemaking. The primary waste management procedure will be the utilization of a RCRA secure landfill constructed in accordance with EPA minimum technology guidelines for hazardous waste landfill construction.

This technology includes the installation of a double liner system with leak detection and leachate collection systems within the landfill. A typical double liner system which can be employed is illustrated in profile and cross-section in Figure 1 and Figure 2. These illustrations are not taken to represent the specific applications for Kennecott operations but do reflect the concept of the double liner system that will be implemented.

The top liner consisting of synthetic material is intended to prevent migration of any hazardous constituents during facility operation or during the 30-year post-closure monitoring period. This liner also serves as the "floor" of the primary leachate collection and removal system. Any leachate

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migrating through the leach pile will accumulate above this liner in the overlying drainage material and be conveyed via a network of drainpipes to a localized collection point.

A second composite liner consisting of a synthetic liner underlain by a natural liner of compacted soil will provide barriers to the migration of leachate into uncontrolled areas bounding the landfill. In addition, this second liner performs functions similar to the first liner with regard to secondary leachate collection and removal.

A final cover consisting of natural and synthetic materials will be provided at the cessation of operation of a given landfill unit. This cover will be designed and constructed to provide long-term minimization of fluid migration into the closed landfill, promote drainage and minimize cover erosion and abrasion, and generally function with a minimum of maintenance.

Post-closure monitoring and surveillance will be conducted for the prescribed 30-year period. This will include maintenance of the final cover, monitoring and maintenance of leak detection and ground water monitoring systems, and general site maintenance as necessary to ensure facility integrity and provide compliance with applicable regulatory requirements.

COST ESTIMATE

GENERAL

Preliminary cost estimates have been developed for the construction, operation, and post-closure maintenance of hazardous waste disposal facilities for each Kennecott operation. For purposes of this report, it is assumed that separate facilities will be constructed for "new production" and existing hazardous waste. The landfills accepting "new production" hazardous waste will have an operating life of 10 years with a regulated post-closure period

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of 30 years. Those facilities accepting existing hazardous waste will operate only for the period of time necessary to dispose of the waste. As with "new production" facilities, post-closure periods will extend for 30 years.

Three general categories of cost estimates have been developed. These include capital costs, operation and maintenance costs, and post-closure costs. Since facilities accepting existing hazardous waste will have a limited operating life, operation and maintenance costs are not developed separately but are included as capital costs. A summary of total categorical costs for each operation is provided in Table 1. A brief description of cost development factors in each category is given in the following sections.

CAPITAL COSTS

Capital costs are taken to include those costs associated with the initial construction, including design and permitting and final closure of the landfill. It has been assumed that the development of land area necessary to receive the anticipated total amount of hazardous waste from a given operation will be a capital cost even though some development may coincide with the operation and maintenance phase. These costs include the excavation of the landfill, construction and placement of all liners, leak detection and ground water monitoring systems, and construction of the final cover. Also included in capital costs is land purchase. Land requirements were predicated on the area necessary to contain the anticipated waste volume with a nominal landfill depth of 20 feet. A buffer zone totaling approximately 30 percent of the total landfill area is also included in the land requirements. The anticipated areal extent of each facility addressed in this report, exclusive of the buffer zone, is as follows:

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o Utah Operation

New Production - 895' x 895' (approximately 18.4 A)
Existing Sludge - 315' x 315' (approximately 2.3 A)
Miscellaneous Waste - 430' x 430' (approximately 4.2 A)

o New Mexico Operation

New Production - 512' x 512' (approximately 6.0 A)

o Arizona Operation

New Production - 340' x 340' (approximately 2.7 A)

The construction and development of the wastewater treatment plant (WWTP) is also included in the capital costs. It is applied as a line item in the cost estimate. More detailed discussions of individual capital cost items are provided in the addendum preliminary feasibility report.

Capital cost estimates developed for waste facilities accepting existing hazardous waste (Utah operation) also include total costs for placement (load, transport, unload) of the waste material. For "new production" facilities, this cost is included as a line item in the yearly operation and maintenance cost estimates.

Estimated capital costs for each operation are given in Tables 2 through 6.

OPERATION AND MAINTENANCE

Yearly cost estimates for operation and maintenance have been developed for landfill facilities which will accept "new production" hazardous waste. Estimated costs are given for placement (load, haul, unload), general facility supervision, administration, and operation including supplies, and ground water monitoring and leachate control. Operation and maintenance costs for

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the wastewater treatment plant (WWTP) are also included. These landfill facilities are assumed to have operating lives of 10 years. Line item yearly cost estimates for each operation are presented in Table 2, Table 5, and Table 6. As indicated previously, yearly operation and maintenance costs are given only for "new operation" facilities.

POST-CLOSURE

Costs are estimated for providing the prescribed maintenance and monitoring activities throughout the post-closure care period (i.e., 30 years). These activities include general site inspections to evaluate the effectiveness and integrity of the final cover, maintenance and monitoring of the leak detection and ground water monitoring systems, and general record keeping. Unacceptable defects of induced breaches in the top liner surface will be repaired when detected and general site maintenance will be performed as necessary to retain acceptable visual aspects of the site. Erosion control features will be maintained and initiated as necessary to promote proper site drainage throughout the care period.

Post-closure cost estimates are presented in Tables 2 through 6.

Cost estimate summaries for all operations are presented in Tables 7 and 8.

OFF-SITE DEVELOPMENT

Cost estimates presented in this report are based on an assumption that a given hazardous waste facility will be developed within approximately two miles of the hazardous waste source. Disposal facilities developed at greater distances will require additional capital or operating expenditures associated with increased transportation costs. Actual site development costs should remain essentially constant. Total expenditure increases will be

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dependent upon the actual haul distance and the total amount of material to be hauled. However, to reflect the general magnitude of the additional costs involved, it is estimated that the additional transportation costs for sites 5 and 50 miles distant from the waste source are as follows:

o Utah Operation

New Production	- 5 mi - \$461,725/yr	50 mi - \$1,385,175/yr
Existing Sludge	- 5 mi - \$570,000	50 mi - \$1,520,000
Existing Miscellaneous Waste	- 5 mi - \$1,075,000	50 mi - \$2,867,000

o New Mexico Operation

New Production	- 5 mi - \$151,000/yr	50 mi - \$404,000/yr
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o Arizona Operation

New Production	- 5 mi - \$ 67,000/yr	50 mi - \$174,000/yr
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We appreciate the opportunity to be of continuing service to you. If you have any questions regarding this report or require additional information, please contact us.

Sincerely,

DAMES & MOORE



Peter F. Olsen
Associate



James R. Boddy
Associate

PFO/fl

Attachments:

- Figure 1 - Schematic, Typical Profile, Double Liner System
- Figure 2 - Schematic, Typical Cross-Section, Double Liner System
- Table 1 - Summary, Estimated Compliance Costs, Hazardous Waste Disposal
- Table 2 - Cost Estimate, Utah Operation, New Production
- Table 3 - Cost Estimate, Utah Operation, Existing Miscellaneous Hazardous Waste
- Table 4 - Cost Estimate, Utah Operation, Existing Sewage
- Table 5 - Cost Estimate, New Mexico Operation
- Table 6 - Cost Estimate, Arizona Operation
- Table 7 - Summary, Estimated Compliance Cost, Utah
- Table 8 - Summary, Estimated Compliance Cost, Arizona and New Mexico

Addenda: Preliminary Feasibility Evaluation, Wastewater Treatment for
Nonferrous Metal Operations, Resource Technologies Group, Inc.

Dimensions and Specifications

Nomenclature

Materials

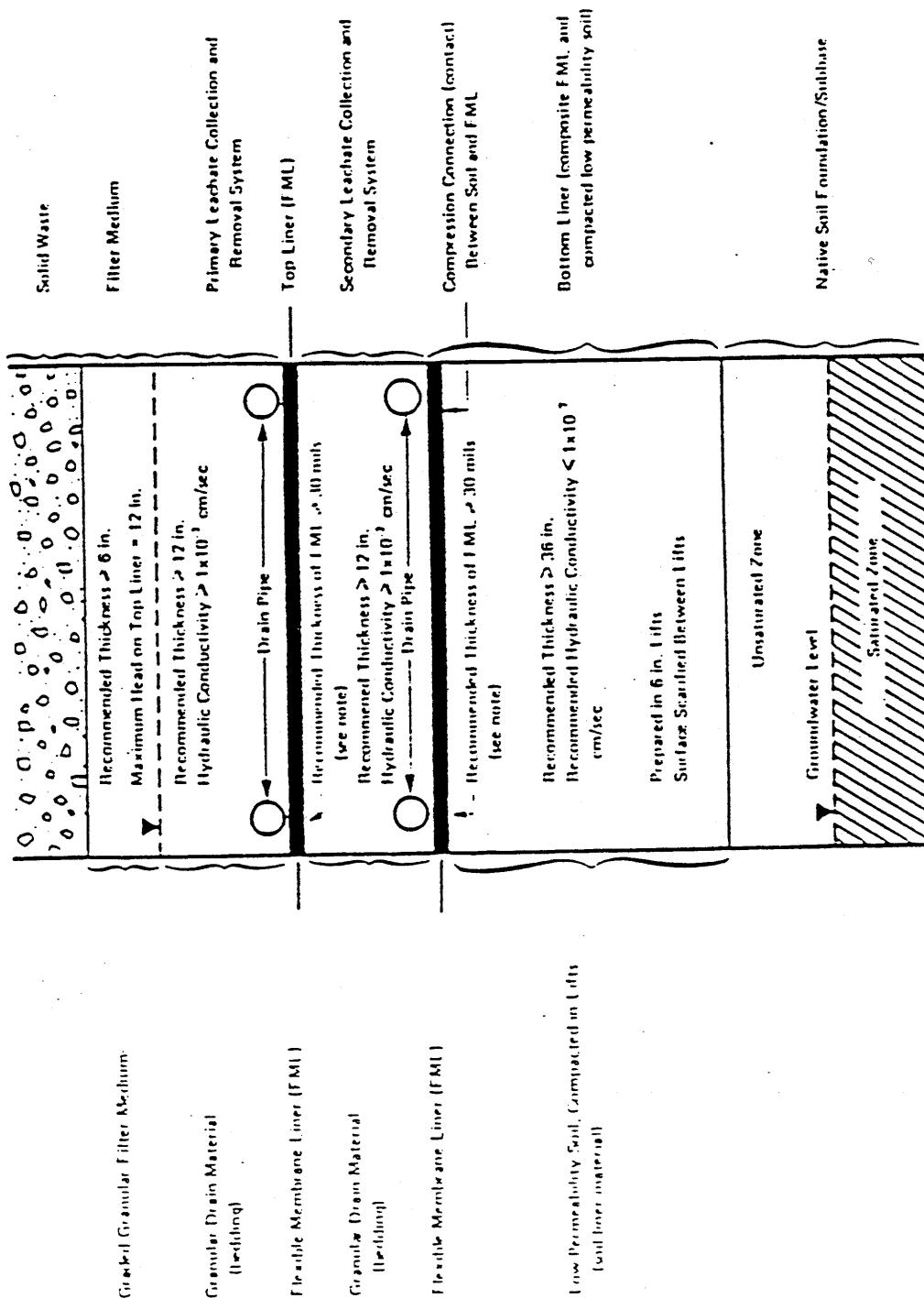


FIGURE 1
SCHEMATIC
TYPICAL PROFILE
DOUBLE LINER SYSTEM

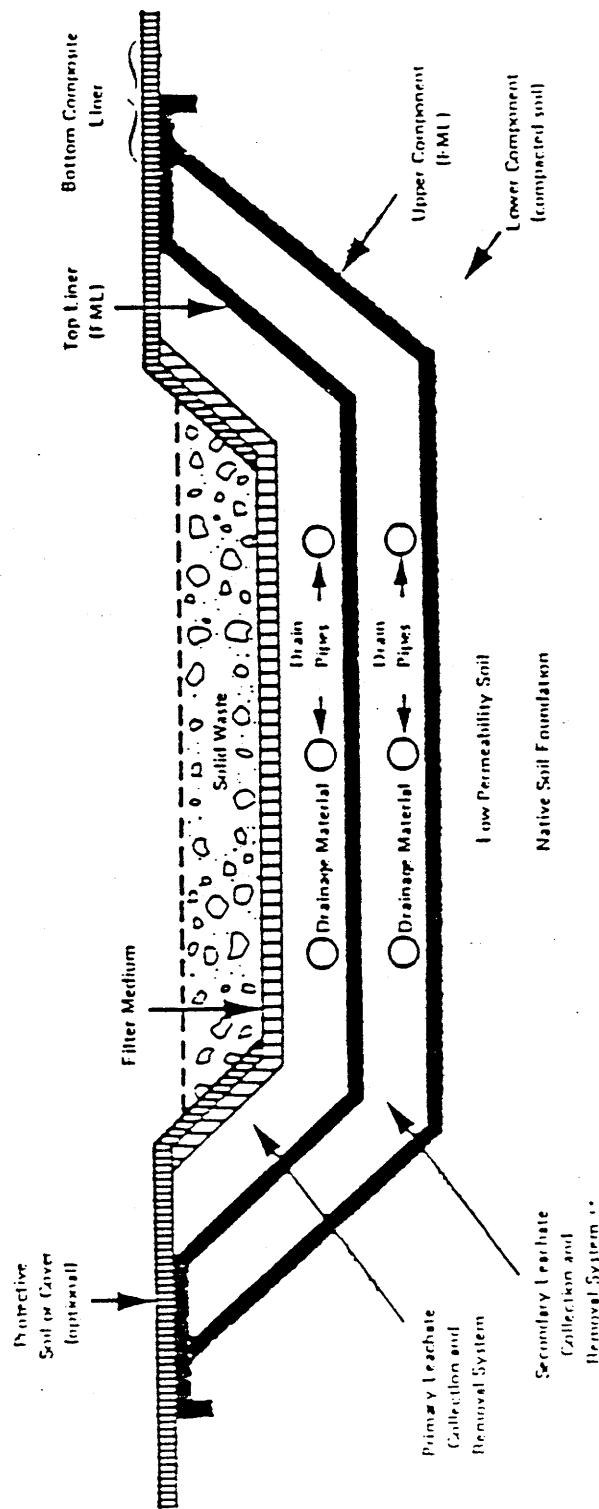


FIGURE 2
SCHEMATIC
TYPICAL CROSS-SECTION
DOUBLE LINER SYSTEM

TABLE 1
SUMMARY
ESTIMATED COMPLIANCE COSTS
HAZARDOUS WASTE DISPOSAL
(Dollars)

	Capital (1)	Operation & Maintenance Yearly (2)	10-Years (3)	Post-Closure Yearly (4)	30-Years (5)	Total (1)+(3)+(5)
UTAH						
Existing Miscellaneous	5,439,000			15,000	450,000	5,889,000
Existing Sludge	3,222,000			12,000	360,000	3,582,000
New Production	11,671,000	8,995,000	89,950,000	25,000	750,000	102,370,000
NEW MEXICO						
New Production	4,566,000	1,510,000	15,100,000	16,000	480,000	20,146,000
ARIZONA						
New Production	2,866,000	1,066,000	10,660,000	13,000	420,000	13,946,000

TABLE 2

COST ESTIMATE - UTAH OPERATION

NEW PRODUCTION

Capital Costs

Excavation/Fill	593,352 CY* @ \$2.00	\$ 1,186,704
Double Liner/Drainage Net	913,800 SF* @ \$1.50	1,370,692
Leak Detection	LS*	250,000
Final Cover		
Liner	913,800 SF @ \$0.50	456,900
Geotextiles	913,800 SF @ \$0.20	182,760
Gravel Drain	29,700 CY @ \$15.00	445,500
Topsoil	59,400 CY @ \$2.00	118,800
Monitor Wells	LS	500,000
Revegetation	36 acres @ \$772.00	27,792
Design and Permitting	LS	907,830
Contingency	LS	1,361,175
Land Purchase	23.9 acres @ \$5,000.00	119,500
WWTP	LS	4,743,600
		<hr/>
	TOTAL	\$11,671,253

Operation and Maintenance
(Yearly)

Placement	92,345 Tons @ \$16.67	\$ 1,539,391
Monitor Well Sample	6 wells (min) @ \$1,500.00	9,000
Maintenance Supplies	LS	116,712
Supervision and Maintenance	LS	227,136
Administration and Operation	LS	279,106
Leachate Treatment	2,800,000 gal @ \$0.10	280,000
Contingency	LS	322,176
WWTP		6,221,805
		<hr/>
	TOTAL	\$ 8,995,326

Post-Closure
(Yearly)

Inspection	LS	\$ 2,340
Monitor Well Sample	6 wells (min) @ \$1,500.00	9,000
Record Keeping	LS	520
Site Maintenance	LS	4,604
Erosion Control	LS	1,764
Leachate Disposal	9,200 gal @ \$0.50	4,600
Contingency	LS	2,283
		<hr/>
	TOTAL	\$ 25,111

* CY = Cubic Yards, SF = Square Feet, LS = Lump Sum

TABLE 3

COST ESTIMATE - UTAH OPERATION
EXISTING MISCELLANEOUS HAZARDOUS WASTE

Capital Costs

Excavation/Fill	138,000 CY @ \$2.00	\$ 276,000
Double Liner/Drainage Net	215,000 SF @ \$2.50	322,500
Leak Detection	LS	125,000
Final Cover		
Liner	215,000 SF @ \$0.50	107,500
Geotextiles	215,000 SF @ \$0.20	43,000
Gravel Drain	6,850 CY @ \$15.00	102,750
Topsoil	13,700 CY @ \$2.00	27,400
Monitor Wells	LS	250,000
Revegetation	8 acres @ \$772.00	6,176
Design and Permitting	LS	252,065
Contingency	LS	315,082
Land Purchase	5.5 acres @ \$5,000.00	27,500
Placement	215,000 Tons @ \$16.67	<u>3,584,050</u>
TOTAL		\$5,439,023

Post-Closure
(Yearly)

Inspection	LS	\$ 1,170
Monitor Well Sample	5 wells (min) @ \$1,500.00	7,500
Record Keeping	LS	520
Site Maintenance	LS	1,617
Erosion Control	LS	1,584
Leachate Disposal	2,500 gal @ \$0.50	1,250
Contingency	LS	<u>1,357</u>
TOTAL		\$ 14,998

TABLE 4

COST ESTIMATE - UTAH OPERATION

EXISTING SLUDGE DEPOSITS

Capital Costs

Excavation/Fill	73,500 CY @ \$2.00	\$ 147,000
Double Liner/Drainage Net	122,535 SF @ \$1.50	183,802
Leak Detection	LS	125,000
Cover		
Liner	122,535 SF @ \$0.50	61,267
Geotextiles	122,535 SF @ \$0.20	24,507
Gravel Drain	3,675 CY @ \$15.00	55,125
Topsoil	7,350 CY @ \$2.00	14,700
Monitor Wells	LS	250,000
Revegetation	5 acres @ \$772.00	3,860
Design and Permitting	LS	175,052
Contingency	LS	265,828
Land Purchase	3 acres @ \$5,000.00	15,000
Placement	114,000 Tons @ \$16.67	<u>1,900,380</u>
	TOTAL	3,221,521

Post-Closure
(Yearly)

Inspection	LS	780
Monitor Well Sample	5 wells (min) @ \$1,500.00	\$ 7,500
Record Keeping	LS	520
Site Maintenance	LS	963
Erosion Control	LS	1,512
Leachate Disposal	1,000 gal @ \$0.50	500
Contingency	LS	<u>498</u>
	TOTAL	\$ 12,273

TABLE 5

COST ESTIMATE - NEW MEXICO OPERATION

Capital Costs

Excavation/Fill	194,200 CY @ \$2.00	\$ 388,400
Double Liner/Drainage Net	296,960 SF @ \$1.50	445,440
Leak Detection	LS	150,000
Final Cover		
Liner	296,960 SF @ \$0.50	148,480
Geotextiles	296,960 SF @ \$0.20	59,392
Gravel Drain	9,710 CY @ \$15.00	145,650
Topsoil	19,420 CY @ \$2.00	38,840
Monitor Wells	LS	250,000
Revegetation	12 acres @ \$772.00	9,264
Design and Permitting	LS	327,093
Contingency	LS	490,639
Land Purchase	7.8 acres @ \$5,000.00	39,000
WWTP		2,073,400
		<u>\$ 4,565,598</u>
TOTAL		

Operation and Maintenance
(Yearly)

Placement	30,295 Tons @ \$16.67	\$ 505,017
Monitor Well Samples	5 wells (min) @ \$1,500.00	7,500
Maintenance Supplies	LS	24,922
Supervision and Maintenance	LS	113,568
Administration and Operation	LS	139,553
Leachate Treatment	1,000,000 gal @ \$0.10	100,000
Contingency	LS	89,056
WWTP	LS	<u>530,511</u>
TOTAL		\$ 1,510,127

Post-Closure
(Yearly)

Inspection	LS	\$ 1,365
Monitor Well Sample	5 wells (min) @ \$1,500.00	7,500
Record Keeping	LS	520
Site Maintenance	LS	1,541
Erosion Control	LS	1,548
Leachate Disposal	4,000 gal @ \$0.50	2,000
Contingency	LS	<u>1,448</u>
TOTAL		\$ 15,922

TABLE 6

COST ESTIMATE - ARIZONA OPERATION

Capital Costs

Excavation/Fill	85,600 CY @ \$2.00	\$ 171,200
Double Liner/Drainage Net	140,080 SF @ \$1.50	210,210
Leak Detection	LS	100,000
Final Cover		
Liner	140,080 SF @ \$0.50	70,040
Geotextiles	140,080 SF @ \$0.20	28,016
Gravel Drain	4,300 CY @ \$15.00	64,500
Topsoil	8,600 CY @ \$2.00	17,200
Monitor Wells	LS	250,000
Revegetation	10 acres @ \$772.00	7,720
Design and Permitting	LS	184,000
Contingency	LS	275,000
Land Purchase	3.4 acres @ \$5,000.00	17,000
WWTP		<u>1,471,600</u>
TOTAL		\$ 2,866,486

Operation and Maintenance
(Yearly)

Placement	13,000 Tons @ \$16.67	\$ 218,610
Monitor Well Sample	5 wells (min) @ \$1,500.00	7,500
Maintenance Supplies	LS	17,682
Supervision and Maintenance	LS	81,120
Administration and Operation	LS	112,528
Leachate Treatment	500,000 gal @ \$0.10	50,000
Contingency	LS	48,354
WWTP	LS	<u>530,511</u>
TOTAL		\$ 1,066,305

Post-Closure
(Yearly)

Inspection	LS	\$ 900
Monitor Well Sample	5 wells (min) @ \$1,500.00	7,500
Record Keeping	LS	520
Site Maintenance	LS	836
Erosion Control	LS	1,440
Leachate Disposal	1,500 gal @ \$0.50	750
Contingency	LS	<u>1,200</u>
TOTAL		\$ 13,146

TABLE 7
SUMMARY
ESTIMATED COMPLIANCE COST
(Dollars)

	UTAH		
	Existing Miscellaneous Hazardous Waste	Existing Sludge Deposits	New Hazardous Waste Production
<u>Capital Costs</u>			
Excavation	\$ 276,000	\$ 147,000	\$ 1,187,000
Liner	323,000	184,000	1,371,000
Leak Detection	125,000	125,000	250,000
Final Cover	281,000	156,000	1,204,000
Monitor Wells	250,000	250,000	500,000
Vegetation	6,000	4,000	28,000
Design & Permit	252,000	175,000	908,000
Contingency	315,000	266,000	1,361,000
Land Purchase	28,000	15,000	120,000
WWTP	NA	NA	4,744,000
Placement	<u>3,584,000</u>	<u>1,900,000</u>	<u>NA</u>
TOTAL	\$ 5,440,000	\$ 3,222,000	\$11,673,000
<u>Operation & Maintenance</u>			
Placement	NA	NA	\$ 1,539,000
Ground Water Monitoring	NA	NA	9,000
Maintenance Supplies	NA	NA	117,000
Supervisory Personnel	NA	NA	227,000
Support Personnel	NA	NA	279,000
Leach Treatment	NA	NA	280,000
Contingency	NA	NA	322,000
WWTP	NA	NA	<u>6,222,000</u>
TOTAL			\$ 8,995,000
<u>Post-Closure</u>			
Inspection	\$ 1,200	\$ 800	\$ 2,300
Ground Water Monitoring	7,500	7,500	9,000
Record Keeping	500	500	500
Site Maintenance	1,600	1,000	4,600
Erosion Control	1,500	500	1,800
Leach Disposal	1,300	1,500	4,600
Contingency	<u>1,400</u>	<u>1,200</u>	<u>2,300</u>
TOTAL	\$ 15,000	\$ 13,000	\$ 25,100

TABLE 8
SUMMARY
ESTIMATED COMPLIANCE COST
(Dollars)

	NEW MEXICO	ARIZONA
	New Hazardous Waste Production	New Hazardous Waste Production
<u>Capital Costs</u>		
Excavation	\$ 388,000	\$ 171,000
Liner	445,000	210,000
Leak Detection	150,000	100,000
Final Cover	392,000	180,000
Monitor Wells	250,000	250,000
Vegetation	9,000	8,000
Design & Permit	327,000	184,000
Contingency	490,000	275,000
Land Purchase	39,000	17,000
WWTP	<u>2,073,400</u>	<u>1,471,600</u>
TOTAL	\$ 4,563,000	\$ 2,867,000
<u>Operation & Maintenance</u>		
Placement	\$ 505,000	\$ 219,000
Ground Water Monitoring	8,000	8,000
Maintenance Supplies	42,000	18,000
Supervisory Personnel	114,000	81,000
Support Personnel	140,000	113,000
Leach Treatment	100,000	50,000
Contingency	91,000	48,000
WWTP	<u>530,000</u>	<u>531,000</u>
TOTAL	\$ 1,530,000	\$ 1,068,000
<u>Post-Closure</u>		
Inspection	\$ 1,400	\$ 900
Ground Water Monitoring	8,000	8,000
Record Keeping	500	500
Site Maintenance	1,500	900
Erosion Control	1,500	1,400
Leach Disposal	2,000	800
Contingency	<u>1,400</u>	<u>1,200</u>
TOTAL	\$ 16,300	\$ 13,700



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PRELIMINARY FEASIBILITY EVALUATION
WASTEWATER TREATMENT FOR
NONFERROUS METAL OPERATIONS

December 2, 1985

Prepared for: Dames & Moore
Salt Lake City, Utah

Prepared by: Resource Technologies Group, Inc.
Denver, Colorado

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1.0 Introduction

Resource Technologies Group, Inc. (RTG) was requested by Dames & Moore of Salt Lake City, Utah to do a preliminary evaluation of a wastewater treatment system for the effluents from three (3) copper milling operations, identified as (1) Utah, (2) New Mexico, and (3) Arizona. The preliminary evaluation considered the following:

- (a) Process Description
- (b) Estimated Capital Cost
- (c) Estimated Operating Cost

The available data base for this evaluation was limited and all capital and operating cost estimates are based on the expected influent composition as provided by Kennecott and the effluent standards determined from 40 CFR Part 421. The influent characteristics of the Utah, New Mexico, and Arizona operations are found in Tables 1 and 2. The Part 421 effluent standards for each of the operations are found in Tables 3, 4 and 5.

The wastewater treatment process flowsheet was developed on the basis of existing literature and RTG water treatment experience. There are no existing laboratory data that confirm that the proposed flowsheet will treat the Kennecott effluent stream to the point of meeting the effluent limitations. Full scale laboratory bench studies would be required to confirm the applicability of the proposed process flowsheet.

Table 1

Influent Characteristics

Utah Operations

<u>Element</u>	<u>Concentration mg/l</u>
Copper	45.6
Lead	16.5
Zinc	17.0
Manganese	0.38
Nickel	15.5
Arsenic	126.7
Selenium	4.00
pH	1.6

- (1) This inflow identified as the "Combined Stream to Treatment"
- (2) These results are provided by Kennecott and are based upon daily composite samples compiled over a one year period during portions of 1983-1984.

Table 2

Influent Characteristics
New Mexico and Arizona Operations

<u>Element</u>	<u>Concentration, mg/l</u>
Silver	0.10
Aluminum	380.00
Arsenic	13.00
Gold	0.04
Beryllium	0.03
Bismuth	0.60
Calcium	130.00
Cadmium	40.00
Cobalt	3.00
Copper	600.00
Iron	3,300.00
Gallium	0.02
Germanium	0.20
Magnesium	100.00
Manganese	38.00
Molybdenum	12.00
Sodium	1,000.00
Nickel	2.50
Lead	35.00
Antimony	less than 7.00
Silicon	130.00
Tin	25.00
Titanium	9.00
Thallium	less than 5.00
Vanadium	0.20
Yttrium	0.40
Zinc	37.00
Zirconium	0.60

- (1) Sample also analyzed for boron, barium, cerium, cesium, chromium, hafnium, mercury and selenium. None were detected.
- (2) Analysis believed to have been done in 1977.
- (3) Data provided to RTG by Kennecott.

Table 3

Effluent Mass Based LimitationsUtah Operation

<u>Element</u>	<u>Average Limit</u>		<u>Maximum Limit</u>	
	<u>lbs/day</u>	<u>Concentration</u>	<u>lbs/day</u>	<u>Concentration</u>
Total Suspended Solids	660	22.0 mg/l	1740	58.0 mg/l
Arsenic	7	0.233 "	22	0.733 "
Cadmium	1	0.033 "	3	0.100 "
Copper	7	0.233 "	20	0.667 "
Lead	1	0.033 "	4	0.133 "
Zinc	5	0.167 "	16	0.533 "
pH	6-9		6-9	

- (1) Effluent limitations for Utah operation provided by Kennecott Based on the NPDES Permit # UT-0000051
- (2) Concentration based on inflow of 2500 gpm

Table 4

Expected Effluent LimitationsNew Mexico Operation

<u>Element</u>	<u>Daily Maximum</u>		<u>Monthly Average</u>	
	<u>lbs/day</u>	<u>Concentration</u>	<u>lbs/day</u>	<u>Concentration</u>
Arsenic	8.81	1.30 mg/l	3.86	0.57 mg/l
Cadmium	1.22	0.18 "	0.47	0.07 "
Copper	7.93	1.17 "	3.80	0.56 "
Lead	1.76	0.26 "	0.81	0.12 "
Zinc	6.31	0.93 "	2.58	0.38 "

- (1) Effluent limitations based on BAT effluent limitations in 40 CFR 421.93, Subpart I, Metallurgical Acid Plants Subcategory, in 50 FR 12253, March 28, 1985
- (2) Acid production rate of 1216 Tons per day used for New Mexico Operations
- (3) Inflow of 565 gpm used to determine concentrations

Table 5

Expected Effluent LimitationsArizona Operations

<u>Element</u>	<u>Daily Maximum</u>		<u>Monthly Average</u>	
	<u>lbs/day</u>	<u>Concentration</u>	<u>lbs/day</u>	<u>Concentration</u>
Arsenic	5.40	1.80 mg/l	2.40	0.80 mg/l
Cadmium	0.78	0.26 "	0.30	0.10 "
Copper	4.98	1.66 "	2.37	0.79 "
Lead	1.08	0.36 "	0.51	0.17 "
Zinc	3.96	1.32 "	1.62	0.54 "

- (1) Effluent limitations based on BAT effluent limitations in 40 CFR 421.93, Subpart I, Metallurgical Acid Plants Subcategory, in 50 FR 12253, March 28, 1985
- (2) Acid production rate of 760 Tons per day used for Arizona Operations
- (3) Inflow of 250 gpm used to determine concentrations

2.0 Process Description

2.1 Background

An evaluation of the influent composition, the effluent limitations and available data from the existing lime treatment system at the Utah operations identified the following areas of concern:

- . The arsenic levels at Utah (126.7 mg/l) and at New Mexico and Arizona (13 mg/l) must be substantially lowered to meet the expected BAT effluent limitations.
- . The present effluent from lime treatment at the Utah operation shown in Table 6 indicates that arsenic, nickel and lead exceed the expected BAT effluent limitations.
- . The selenium concentration in the influent at the Utah Operations (3.6 mg/l selenium) may present problems if it is not substantially lower in the effluent. Although there is no BAT effluent limitation for selenium, it would not be unusual for a regulatory agency to set a site specific limit for selenium discharge.

To address the above concerns, RTG evaluated the existing technology for the removal of arsenic, selenium, nickel and lead from wastewater streams. This evaluation follows:

- . Arsenic - It is believed that arsenic could be effectively removed by coprecipitation with ferric iron at a low pH (approx. pH 6) and also by treatment with sulfide⁽¹⁾. Coprecipitation with ferrous iron has also been used and promising results have been reported⁽²⁾.

Table 6

Existing Utah Operations Effluent

<u>Element</u>	<u>lbs/day</u>	<u>(2) Concentration</u>
Arsenic*	141	4.7 mg/l
Copper *	8.40	0.28 "
Nickel	12.0	0.40 "
Lead*	49.8	1.66 "
Zinc	2.4	0.08 "
Selenium	19.8	0.66 "
Manganese	0.90	0.03 "

(1) Data based on daily composite samples for a one year period during 1983-1984 using a lime treatment to pH 12.

(2) Based on 2500 gpm.

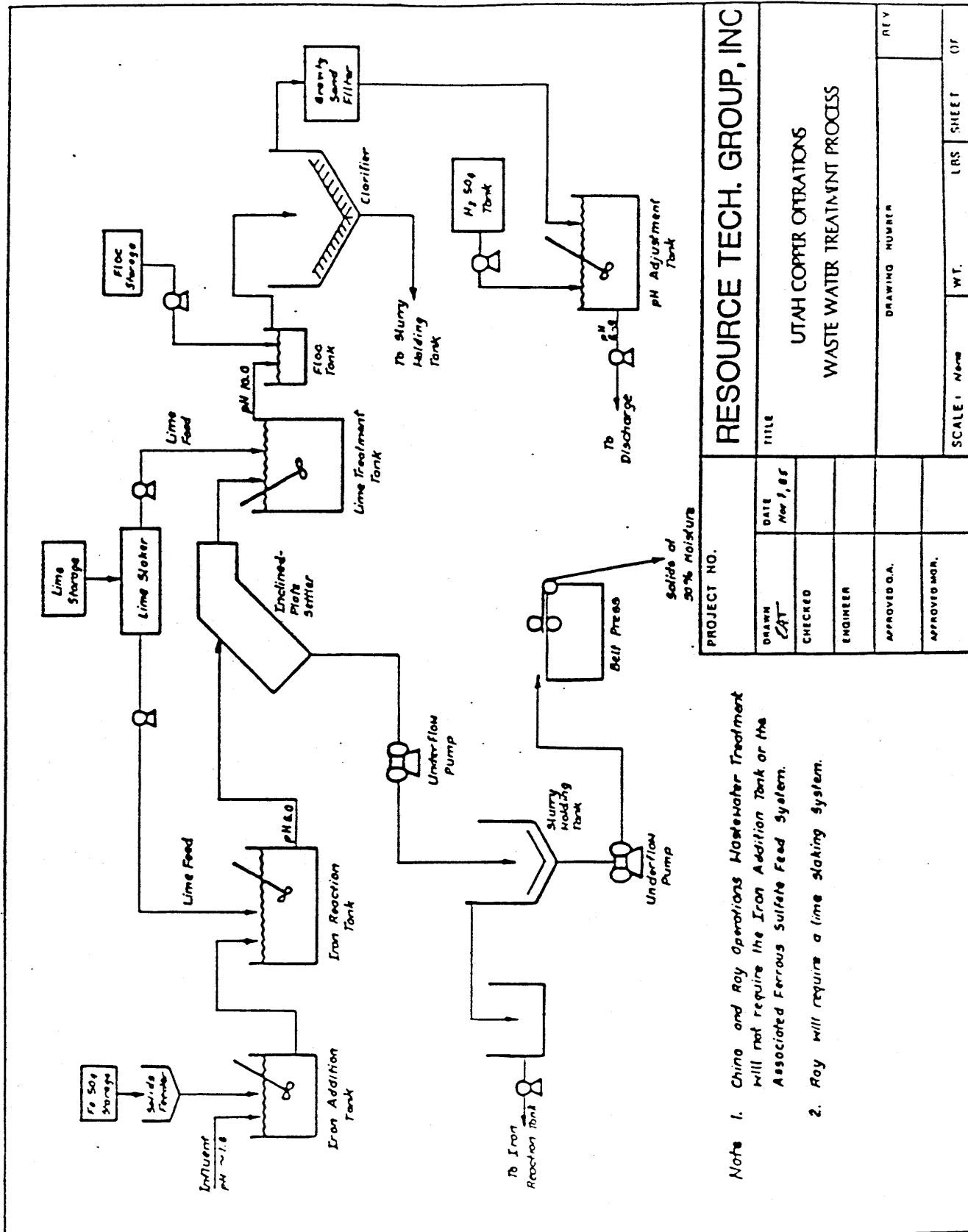
* Values exceed the Effluent Mass based limitations in Table 3.

- . Selenium - The most common method of selenium removal is by reduction in acid media to selenium metal followed by lime treatment. The lime treatment is usually carried out at a pH of less than 7 to prevent redissolution. Sulfur dioxide and ferrous iron have been used as reductants for selenium.

Sulfide precipitation in conjunction with lime precipitation has also been reported to be effective⁽¹⁾. If a sulfide precipitation was required to remove arsenic and selenium, there would be no significant change in the process flowsheet or the capital cost. The only change in the flowsheet would be the addition of sulfide in the form of sodium sulfide, sodium bisulfide, or iron sulfide to the lime treatment tank and all the other equipment on the flowsheet would still be utilized. If sulfide precipitation was used, the operating cost would increase by \$0.50 to \$1.50/1000 gallons. This cost is a function of total metal concentration in the influent solution.

- . Nickel can be removed as the hydroxide to a level of 0.001 mg/l at a pH of 10. It is not understood why the existing system did not remove the nickel to that level.
- . Lead - Lead is normally removed by precipitation as the hydroxide. However, above a pH of 9, lead exhibits amphoteric behavior and hence, the precipitated lead redissolves⁽³⁾. Coprecipitation with ferrous iron has been shown to be an effective method of removing lead without redissolution problems.

After the above evaluation, a typical generic flowsheet for water treatment at the three operations was developed and is shown in Figure 1. The modifications of this flowsheet required at the various operations will be addressed in the following description of the unit operations.



RESOURCE TECH. GROUP, INC

UTAH COPPER OPERATIONS
WASTE WATER TREATMENT PROCESS

- Note 1. Chino and Ray Operations Wastewater Treatment will not require the Iron Addition Tank or the Associated Ferrous Sulfate Feed System.
2. Ray will require a lime slaking system.

2.2 Unit Operations

2.2.1 Chemical Treatment and Settling

The initial step in the process consists of treatment with ferrous sulfate heptahydrate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$). The ferrous iron will reduce selenium to the metal and will also provide a coprecipitant for arsenic. After ferrous iron addition (at a ratio of 3 parts iron as metal to one part metal in the influent), the pH is increased to 6 with lime. Approximately 10% of the ferrous iron and any ferric iron that is present will precipitate along with the majority of the selenium and the arsenic. The precipitated metals are then separated in a settler and the overflow reports to a pH adjust tank. The underflow reports to a slurry tank for subsequent dewatering.

It should be noted that at the New Mexico and Arizona operations, it will not be necessary to add any iron since the influent will contain 3,300 mg/l of iron and, since the influent does not contain selenium, there is no specific need for ferrous iron. The flowsheet for New Mexico and Arizona would be modified to show pH adjustment to 6.0 with lime to remove the arsenic by coprecipitation with iron.

2.2.2 Lime Treatment, Settling and Neutralization

After separation of arsenic and selenium (if present), the pH of the solution is increased to 10 with lime. The remaining ferrous iron will precipitate and will remove virtually all of the heavy metals by coprecipitation. A flocculant will then be added and the treated solutions will report to a clarifier. The overflow from the clarifier will go to a gravity sand filter and the underflow to a slurry tank subsequent to dewatering with a belt filter. The clarified overflow will then go to a neutralization tank where the pH will be adjusted to pH 6-9 prior to discharge.

3.0. Capital Cost Estimates

The capital costs for the three (3) wastewater treatment facilities (Utah, New Mexico and Arizona) were developed from the process flowsheet information. Capital costs were obtained for all process equipment and installation costs were added to the capital cost. The capital costs in the construction account codes were developed from historical records on similar projects. Equipment lists and capital cost summaries are found in Tables 7 through 12.

The expected accuracy from this type of estimate is 30%. Therefore, a contingency account of 30% is added into the capital cost to cover omissions.

The Utah wastewater treatment plant was sized for 2500 gpm with the capability of handling flow surges of up to 4500 gpm. The New Mexico wastewater treatment plant is sized for 565 gpm with the capability of handling surges of up to 815 gpm. The Arizona wastewater treatment plant is sized for 250 gpm with the capability of handling surges of up to 400 gpm.

Table 7

EQUIPMENT LISTUTAH WASTEWATER TREATMENT PLANT

<u>Item #</u>	<u>Description</u>	<u>Installed Cost</u>
1.	Reaction Tanks, (2) TK-1 & TK-2 14'0 x 12' H FRP Tanks	\$ 24,600
2.	Agitators, (2) Ag-1 & Ag for TK-1 & TK-2 complete with 5 Hp motor and 304 SS shaft and impeller	11,600
3.	Reaction Tanks, (2) TK-3 & TK-4 16'0 x 18' H FRP Tanks	45,000
4.	Agitators, (2) Ag-3 & Ag-4 for TK-3 & TK-4 complete with 7-1/2 Hp motor and 304 SS shaft and impeller	16,000
5.	Inclined plate settler (3) operated in parallel. Each is 27'x27'x14' in size	476,300
6.	Underflow Pump for settlers 110 gpm at 30 ft TDH with 2 Hp motor	1,500
7.	Reaction Tank, (3) TK-5, TK-6 & TK-7 16'0 x 16' H FRP Tanks	63,000
8.	Agitators, (3) Ag-5, Ag-6 & Ag-7 complete with 7-1/2 Hp motor and 304 SS shaft and impeller	24,000
9.	Flocculator Tank, TK-8, 14'0 x 12'H FRP Tank	12,300
10.	Agitator, Ag-8, for TK-8 complete with 5 Hp motor and 304 SS shaft and impeller	5,800
11.	Clarifier 76'0	243,000
12.	Gravity sand filters (3) 18'0 units including vessel, immediate piping, controls, integral backwash storage compartment, air blower and filter media	157,500
13.	pH adjust tank, TK-9, 14'0 x 12'H FRP Tank	12,300
14.	Agitator, Ag-9, for TK-9 complete with 5 Hp motor and 304 SS shaft and impeller	5,800

Table 7 (cont'd)

EQUIPMENT LISTUTAH WASTEWATER TREATMENT PLANT

<u>Item #</u>	<u>Description</u>	<u>Installed Cost</u>
15.	Effluent discharge pump, (2) horizontal ANSI style pump complete with 30 Hp motor	18,400
16.	Ferrous sulfate feeder. Gravimetric type feeder complete with 3/4 Hp motor	7,200
17.	Ferrous sulfate storage silo 2500 ft ³	24,000
18.	Lime slurry feed pump to TK-2 20 gpm at 30 ft TDH with 3/4 Hp motor	1,500
19.	Lime slurry pump to TK-3 with 1/4 Hp motor	1,100
20.	Slurry holding tank with mechanism and rake 15'0	28,000
21.	Underflow pump 90 gpm at 40 ft TDH. Air operated diaphragm pump	1,800
22.	Belt Press (2) to dewater the solids to 50% by weight	500,000
23.	Filtrate pump. 150 gpm at 100 ft TDH with 5 Hp motor	<u>2,200</u>
TOTAL EQUIPMENT COST		\$1,682,900

Table 8
UTAH FLOWSHEET
ESTIMATE SUMMARY

<u>Account Code</u>	<u>Description</u>	<u>Cost</u>
A	Earthwork	\$ 210,000
B	Concrete	300,000
C	Buildings & Structures	250,000
D	Process Equipment	1,682,900
E	Piping	350,000
F	Electrical	175,000
G	Painting	40,000
N	Instruments & Controls	110,000
M	Startup	<u>55,000</u>
Subtotal		3,172,900
Engineering (10% of Subtotal)		317,300
Construction Management (5% of Subtotal)		158,700
Contingency (30% of above)		<u>1,094,700</u>
TOTAL ESTIMATED CAPITAL COST		\$4,743,600

Table 9

EQUIPMENT LISTNEW MEXICO WASTEWATER TREATMENT PLANT

<u>Item #</u>	<u>Description</u>	<u>Installed Cost</u>
1.	Reaction Tank, (2) TK-1 & TK-2 10'0 X 10' H FRP Tanks	\$ 18,400
2.	Agitator, (2) Ag-1 & Ag-2 for TK-1 & TK-2 complete with 3 Hp motor and 304 SS shaft and impeller	9,000
3.	Inclined plate settler (2) with flash mixer. 20' x 16' x 12'	170,000
4.	Underflow pump for settler. 25 gpm @ 30 ft TDH with 3/4 Hp motor	1,200
5.	Reaction Tank, (2) TK-3 & TK-4 12'0 x 12' H FRP Tank	21,000
6.	Agitator, (2) Ag-3 & Ag-4 for TK-3 & TK-4 complete with 5 Hp motor and 304 SS shaft and impeller	11,600
7.	Flocculator Tank, TK-5, 8'0 x 8'H FRP Tank	8,000
8.	Agitator, Ag-5, for TK-5 complete with 3 Hp motor and 304 SS shaft and impeller	4,500
9.	Clarifier 48'0	146,200
10.	Gravity Sand Filter 12'0 unit complete including vessel, piping, controls, integral backwash storage, air blower, & filter media	32,800
11.	pH Adjust Tank, TK-6, 8'0 x 8'H FRP Tank	8,000
12.	Agitator, Ag-6, for TK-6 complete with 3 Hp motor and 304 SS shaft and impeller	4,500
13.	Effluent Discharge Pump, (2) horizontal ANSI style pump complete with 10 Hp motor	13,000
14.	Lime slurry metering pump for TK-1	1,800
15.	Lime slurry metering pump for TK-2	1,800
16.	Slurry holding tank with drive and rake	17,000

Table 9 (cont'd)

EQUIPMENT LIST

NEW MEXICO WASTEWATER TREATMENT PLANT

<u>Item #</u>	<u>Description</u>	<u>Installed Cost</u>
17.	Underflow pump, air operated diaphragm pump	1,500
18.	Belt Filter Press	190,000
19.	Filtrate Pump	<u>1,500</u>
	TOTAL EQUIPMENT COST	\$661,800

Table 10

NEW MEXICO FLOWSHEETESTIMATE SUMMARY

<u>Account Code</u>	<u>Description</u>	<u>Cost</u>
A	Earthwork	\$110,000
B	Concrete	150,000
C	Buildings & Structures	120,000
D	Process Equipment	661,800
E	Piping	145,000
F	Electrical	100,000
G	Painting	15,000
N	Instruments & Controls	60,000
M	Startup	<u>25,000</u>
Subtotal		1,386,800
Engineering (10% of Subtotal)		138,700
Construction Management (5% of Subtotal)		69,400
Contingency (30% of above)		<u>478,500</u>
TOTAL ESTIMATED CAPITAL COST		\$2,073,400

Table 11

EQUIPMENT LISTARIZONA WASTEWATER TREATMENT PLANT

<u>Item #</u>	<u>Description</u>	<u>Installed Cost</u>
1.	Reaction Tank, TK-1, 10'0 x 10'0 H FRP Tank	\$ 9,200
2.	Agitator, Ag-1, for TK-1 complete with 3 Hp motor and 304 SS shaft and impeller	4,500
3.	Incline plate settler (2) with flash mixer 14' x 14' x 6'	80,000
4.	Underflow pump for settler	1,200
5.	Reaction Tank, TK-2, 10'0 x 12'H FRP Tank	10,000
6.	Agitator, AG-2, for TK-2 complete with 3 Hp motor and 304 SS shaft and impeller	4,500
7.	Flocculator Tank, TK-3, 6'0 x 8'H FRP Tank	4,200
8.	Agitator, AG-3, for TK-3 complete with 2 Hp motor and 304 SS shaft and impeller	3,200
9.	Clarifier 28'0	81,400
10.	Gravity Sand Filter. 12'0 unit complete including vessel, piping, controls, integral backwash storage, air blower & filter media	32,000
11.	pH adjust tank, TK-4, 6'0 x 12'H FRP Tank	4,200
12.	Agitator, AG-4, for TK-4 complete with 2 Hp motor and 304 SS shaft and impeller	3,200
13.	Lime slurry metering pump for TK-1	1,800
14.	Lime slurry metering pump for TK-2	1,800
15.	Slurry holding tank with drive and rake	15,000
16.	Underflow pump - air operated diaphragm pump	1,500
17.	Belt Filter Press	140,000
18.	Filtrate Pump	1,500
19.	Lime slaking system complete with 1800 ft ³ storage silo, slaker, and lime slurry holding tank	<u>165,000</u>
	TOTAL EQUIPMENT COST	\$564,200

Table 12

ARIZONA FLOWSHEETESTIMATE SUMMARY

<u>Account Code</u>	<u>Description</u>	<u>Cost</u>
A	Earthwork	\$ 50,000
B	Concrete	80,000
C	Buildings & Structures	60,000
D	Process Equipment	564,200
E	Piping	95,000
F	Electrical	55,000
G	Painting	10,000
N	Instruments & Controls	50,000
M	Startup	<u>20,000</u>
Subtotal		984,200
Engineering (10% of subtotal)		98,500
Construction Management (5% of subtotal)		49,300
Contingency (30% of above)		<u>339,600</u>
TOTAL ESTIMATED CAPITAL COST		\$1,471,600

4.0 Operating Cost Estimate

The chemical and electrical operating costs for each of the three operations were estimated and can be found in Tables 13, 14, and 15. The major difference in the Utah chemical costs when compared to New Mexico and Arizona is the cost of the ferrous sulfate heptahydrate. Lime, flocculant and acid costs per 1000 gallons are identical for all operations.

No estimates for labor and maintenance costs have been included in this evaluation.

The cost associated with the handling and disposal of sludge generated in the water treatment process is being evaluated by others. The estimated amount of sludge generated can be found in Table 16.

The sludge generated is composed of gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) and metal hydroxides. The larger quantities of sludge per 1000 gallons generated at New Mexico and Arizona are a result of the high concentrations of dissolved metals in the influent.

Table 13

OPERATING COST ESTIMATEUTAH OPERATIONS

<u>Chemical Cost</u>	<u>lbs/1000 gal</u>	<u>\$/1000 gal</u>
Ferrous Sulfate heptahydrate	28.0	2.80
Lime ⁽¹⁾	19.3	0.965
Flocculant	0.025	0.025
H ₂ SO ₄	< 0.05	<u>0.01</u>
		3.80
<u>Electrical Cost</u>		
115 Installed H.P.		<u>.038</u>
TOTAL - Chemical and Electrical		\$3.838

- (1) Lime requirement estimated using a lime utilization factor of 0.8.
- (2) 115 H.P. estimate includes process pump, rakes, filters, compressor. Cost of \$0.065/Kw-hr assumed for this estimate.

Table 14

OPERATING COST ESTIMATENEW MEXICO OPERATIONS

<u>Chemical Costs</u>	<u>lbs/1000 gal</u>	<u>\$/1000 gal</u>
Lime ⁽¹⁾	19.3	0.965
Flocculant	0.025	0.025
H ₂ SO ₄	< 0.05	<u>0.01</u>
		\$ 1.00

Electrical Cost

50 Installed H.P. ⁽²⁾	<u>0.16</u>
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TOTAL - Chemical and Electrical	\$ 1.16
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- (1) Lime requirements estimated using a lime utilization factor of 0.8.
- (2) 50 H.P. estimate includes process pumps, rakes, filters, and compressor. Cost of \$0.065/Kw-hr assumed for this estimate.

Table 15

OPERATING COST ESTIMATEARIZONA OPERATIONS

<u>Chemical Costs</u>	<u>lbs/1000 gal</u>	<u>\$/1000 gal</u>
Lime ⁽¹⁾	19.3	0.965
Flocculant	0.025	0.025
H ₂ SO ₄	< 0.05	<u>0.01</u>
		1.00
<u>Electrical Cost</u>		
50 Installed H.P. ⁽²⁾		<u>0.072</u>
TOTAL - Chemical and Electrical		\$1.072

- (1) Lime requirements estimated using a lime utilization factor of 0.8.
- (2) 50 H.P. estimate includes process pumps, rakes, filters, compressor. Cost of \$0.065/Kw-hr assumed for this estimate.

Table 16

SLUDGE GENERATION⁽¹⁾

<u>Operation</u>	<u>lbs/1000 gal</u>	<u>Tons/day</u>
Utah (2500 gpm)	70.2	126.4
New Mexico (565 gpm)	101	41.1
Arizona (250 gpm)	101	18.2

- (1) All estimates based on weight of dry sludge. The moisture content of the product from the belt filter is estimated at 50%. Thus, the weight of cake from the filter will be approximately twice the weight of dry sludge.

5.0 Summary and Recommendations

The capital cost and the operating cost for each of the operations are shown in Table 17.

Refinement of these estimates could be accomplished by a number of methods which include:

- . Better characterization of the influent streams, particularly for New Mexico and Arizona operations.
- . A laboratory program on the influent streams to optimize the treatment technology and chemical requirements.
- . Availability of more data from the existing treatment system.

Table 17

Summary

<u>Operation</u>	<u>Flow</u>	<u>Capital Cost Estimate</u>	<u>Operating Cost Estimate \$/1000 gallons</u>
Utah	2500 gpm	\$4,743,600	\$3.838
New Mexico	565 gpm	\$2,073,400	\$1.160
Arizona	250 gpm	\$1,471,600	\$1.072

6.0 References

- (1) Environmental Protection Agency. "Proposed Development Document for Effluent Limitations, Guidelines and Standards for Nonferrous Metals, General Development Document I", EPA-440/1-84-019b, July 1984.
- (2) Environmental Protection Agency. "Sources and Treatment of Wastewater in the Nonferrous Metal Industry", EPA-600/2-80-074, April 1980.
- (3) Williams, Roy E., "Waste Production and Disposal in Mining, Milling and Metallurgical Industries", Miller Freeman Publications, 1975.

DAMES & MOORE JOB NO. 01375-062-06
Salt Lake City, Utah
December 13, 1985

REPORT
COST ESTIMATE
COMPLIANCE WITH PROPOSED RULEMAKING
REINTERPRETATION OF THE
SMELTING AND REFINING WASTE EXCLUSION
FOR KENNECOTT

File in:

- ☐ Confidential
☐ Shelf
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Refer to Record No. 0019 Date 12/13/85
In M/ 035/002, 1985, Incoming
For additional information